THE RELATIONSHIP BETWEEN CONTEXT AND SENSORY PROCESSING PATTERNS IN CHILDREN WITH AUTISM

BY

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Table of Contents

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Abstract

Objective

The purpose of this study was to determine the relationship between sensory processing and context for children with autism 3 to 11 years old. Researchers examined home and school contexts using the Sensory Profile (home) and the School Companion (school).

Method

Teachers of 49 students with autism completed the School Companion and parents completed the Sensory Profile. Researchers conducted correlational analyses using the Avoiding and Seeking Quadrant Scores from the School Companion and the corresponding Avoiding and Seeking Quadrant Scores from the Sensory Profile.

Results

The Avoiding Quadrant Score coefficient (.59) and the Seeking Quadrant Score coefficient (.45) were statistically significant (p = .01) with good and fair correlations respectively suggesting sensory processing patterns have both universal qualities and context specific qualities in children with autism.

Conclusion

Findings from this study provide initial evidence that there is a relationship between sensory processing and context for children with autism.

The Relationship between Context and Sensory Processing Patterns in Children with Autism

Introduction

The prevalence of autism in the United States is 1 in 150 births and affects more boys than girls (4.8:1) (Center for Disease Control and Prevention, 2007). Autism is a neurodevelopmental disorder characterized by impairments in social skills, nonverbal and verbal communication, and involves repetitive behaviors and unusual interests (American Psychiatric Association, 2000; Corsello, 2005; Rapin, 1991). In addition to these core characteristics, many children with autism have unusual ways of learning, attending, and responding to sensory experiences (Rapin, 1991; Strock, 2004); this area of consideration has been receiving more attention in the last decade.

Sensory Processing Concepts

Scholars continue to advance the study of sensory processing since Sensory Integration theory was first developed by Jean Ayres (1972). Dunn's Model of Sensory Processing is based in knowledge from neuroscience and behavioral science (Dunn, 1997) (see Figure 1). The model conceptualizes the contribution of sensory processing to a child's behavior, helping us to further understand the child. Dunn's model hypothesizes there is an interaction between neurological thresholds and behavioral responses (Dunn, 1997). In Figure 1, the neurological thresholds (i.e. the vertical axis) indicate the amount of stimuli needed for the child to notice or react to

the stimuli. The behavioral responses (i.e. the horizontal axis) indicate the manner in which the child responds to the stimuli.

According to Dunn's Model of Sensory Processing (Dunn, 1997), both neurological thresholds and behavioral responses are on a continuum that interact with each other. The intersection of these two continua results in four sensory processing patterns (i.e. Registration, Seeking, Sensitivity, and Avoiding) which offer possible interpretations of a child's behavior (Dunn, 2006a). Registration is described as the degree to which a child misses sensory input (high neurological threshold and passive response). Seeking is the degree to which a child obtains sensory input. Children in the Seeking quadrant also have a high neurological threshold but respond actively. Children with low neurological thresholds fall into the Sensitivity or Avoiding quadrants. Sensitivity is the degree to which a child notices sensory input (passive response) and Avoiding is the degree in which a child is bothered by sensory input (active response). The interaction of neurological thresholds and behavioral responses provide a method for explaining how children process sensory information and provides guidance for intervention planning (Dunn, 1999).

Sensory Processing and Children with Autism

One of the many difficulties children with autism face is an unusual way of responding to sensory experiences (Center for Disease Control and Prevention, 2007; Rapin, 1991; Strock, 2004). Children with autism may be sensitive and overreact to auditory stimulation and withdraw (Case-Smith & Bryan, 1999). They may also seek

out proprioceptive and vestibular input through self-stimulatory, repetitive behaviors such as rocking, spinning, or flapping their hands (Case-Smith & Bryan, 1999). The unique sensory processing patterns in children with autism are associated with dysfunction in attending, arousal, interactions with others, and goal-directed play (Case-Smith & Bryan, 1999; Greenspan & Wieder, 1997; Wieder, 1996).

Furthermore, research has shown that sensory processing affects a child's ability to learn (Ayres, 1979; Dunn, 2001; Dunn & Donaldson, 2001). Specifically, children with autism often fail to notice sensory input that is important, and other times are overly sensitive to sensory input and withdraw from stimuli (Ermer & Dunn, 1998; Kientz & Dunn, 1997; Ornitz, 1974; Rapin, 1991; Tomchek & Dunn, 2007; Watling, Deitz, & White, 2001). This pattern of responding makes it difficult for the child to learn because the child misses important information needed to profit from instruction, becoming especially important at school. For these reasons, education teams need the appropriate tools to identify and design effective interventions specific to the education context.

Evaluation within the Educational System

With a cause for autism not yet understood, much of the focus is on effective interventions for children with autism. Due to federal laws and the fact children spend most of their day at school, the educational system is expected to provide much of the instruction and intervention for children with autism (*IDEA*, 1990; *IDEA*, 2004; *No Child Left Behind Act*, 2001). The public schools must be ready to provide support so these children might be successful with their peers at school. Including

assessment of sensory processing in the educational assessment plans of children who have autism may facilitate individualized intervention planning.

However, one critical factor the education system faces in serving children with autism involves conducting valid and reliable assessments. Assessments are used to determine children's learning strengths and needs. Many authors suggest children's reaction to sensation may interfere with both assessment and educational planning (Ayres, 1979; Case-Smith & Bryan, 1999; Case-Smith & Miller, 1999; Cook, 1991; Kientz & Dunn, 1997; Larson, 1982). If we are better able to understand children's reaction to sensation, particularly their sensory processing patterns, then professionals will have important information to guide educational planning.

Methods for Assessing Sensory Processing

Behavior is influenced by context and therefore it is important to consider a person's context when considering his/her potential to learn (Dunn, Brown, & McGuigan, 1994). The Sensory Profile (Dunn, 1999), which is based on Dunn's Model of sensory processing, has been used in many interdisciplinary studies to document sensory processing patterns in children and adults with and without disabilities (Brown et al., 2001; Dunn, 1994; Dunn & Bennett, 2002; Ermer & Dunn, 1998; Kientz & Dunn, 1997; Watling, Dietz, & White, 2001). However, behaviors assessed by the Sensory Profile are not specific to behaviors that would occur in the classroom setting, where a school-aged child spends most of his/her day.

Home and school contexts are unique and, therefore, contextually relevant assessments are essential. At this time, there are only two published sensory

processing assessments specifically for use in the schools. The Sensory Processing Measure - School (SPM - School), a measure based on Sensory Integration theory, provides standard scores for children five to twelve years old in the areas of praxis and social participation, as well as visual, auditory, tactile, proprioceptive and vestibular sensory systems (Miller-Kuhaneck, Henry, Glennon, & Mu, 2007). The SPM-School forms are completed by a primary classroom teacher (Main Classroom Form) and other school personnel (School Environments Form) using a 4-point Likert scale. Since the SPM-School is a new assessment, studies using the SPM-School as a measure have yet to be published. However, the authors provide literature on the reliability and validity of the assessment. To investigate the reliability of the SPM-School, the authors examined the internal consistency of the assessment items using the Cronbach's alpha coefficient (Miller-Kuhaneck et al., 2007). The SPM-School's authors reported .70 to .99 correlation ranges. Miller-Kuhaneck, et al. (2007) also report the SPM-School has face validity or the assessment appears to test what it is intended to test, which is the least rigorous measurement for validity (Portney & Watkins, 2000).

The second available school-based sensory processing assessment is the Sensory Profile School Companion (hereafter referred to as the School Companion) (Dunn, 2006a). The School Companion is built on Dunn's Model of Sensory Processing (Dunn, 1997) (see Figure 1), and so coordinates findings with the well established Sensory Profile. The School Companion reflects scores that are grounded in tested theoretical concepts from the literature (i.e., sensory processing patterns:

Seeking, Avoiding, Sensitivity and Registration) providing insights into the child's sensory patterns in the context of school. The School Companion also offers sensory system scores (i.e., visual, auditory, touch, movement) and a behavior score. Because teachers are completing this form, there are also four School Factor Scores, reflecting the teacher and classroom perspectives. The School Companion is designed for children aged three to eleven years old. The child's teacher uses a 5-point Likert scale to complete the 62 item questionnaire regarding the child's responses to daily sensory experiences in the classroom. Only one form is needed since the classroom teacher knows the student the best and is more likely to be able to report the student's reactions. Additionally, the School Companion is designed to be used in conjunction with the Sensory Profile (Dunn, 1999) which solicits the caregivers' input, providing a comprehensive view of the child's sensory processing patterns.

Like the authors of the SPM-School, Dunn (2006a) used the Cronbach's alpha coefficient to report reliability of the School Companion with correlations ranging from .83 to .95. Dunn also reports test-retest reliability coefficients ranging from .80 to .95 reflecting good to excellent stability of scores from the first rating the teacher reported on a child to the second rating the teacher reported on the same child (Dunn, 2006a).

To test validity of the School Companion, the scores from the teacher responses on the School Companion were correlated with scores from the parent responses on the Sensory Profile and indicated contrasting high and low correlations, providing evidence of both convergent and discriminant validity (Dunn, 2006a).

Convergent and discriminant validity are types of construct validity, which is the ability of an instrument to measure an abstract concept or construct (Portney & Watkins, 2000). Convergent validity indicates that two assessments reflect the same concept, while discriminant validity indicates that the two assessments assess different characteristics (Portney & Watkins, 2000). With the added information about validity combined with a common conceptual basis for the assessments, the Sensory Profile and School Companion were used for this study of home and school contexts.

Identifying the Best Source for Evaluation Information

Research shows when teachers and parents are asked the same questions about a child, the responses are only slightly correlated suggesting that each informant has a unique view and one could not be substituted for the other (Achenbach, McConaughy, & Howell, 1987; De Los Reyes & Kazdin, 2005; de Nijs et al., 2004; Kumpulainen et al., 1999). The low correlations between teacher and parent responses using the same questionnaire also suggest the variables differ from home and school and indicate the need for contextually designed assessments as well as different interventions and goals (Achenbach et al., 1987).

There is a question about how home and school versions of sensory processing assessments relate to each other. If assessment of sensory processing is only about the children's reactions, then home and school assessment will be highly correlated. If however, the contexts of the children's reactions are an important factor, then there will be both similarities and differences that perhaps indicate the

contribution of context to behavior. For this study, we hypothesized that the most difference between parent and teacher responses would be seen in the two Active Behavioral Response quadrants from Dunn's Model of Sensory Processing (i.e., Avoiding and Seeking). Perhaps the Active quadrant behaviors would be more noticeable making it easier for the parents and the teacher to report behaviors.

In sum, there is a strong need for effective assessment and intervention for children with autism. The school system is expected to provide specialized instruction to meet the unique learning needs of all children. Research has shown that children with autism have unique sensory processing patterns affecting the way in which they respond in their everyday lives, including home and school (Ermer & Dunn, 1998; Kientz & Dunn, 1997; Ornitz, 1974; Rapin, 1991; Tomchek & Dunn, 2007; Watling, Deitz, & White, 2001). Being able to determine how specific sensory processing patterns might relate to participation at home and school will help professionals support children, families and teachers by showing how we might adjust the context to better fit children's needs in each context.

The purpose of this study is to determine the relationship between sensory processing and context. To address this purpose, we examined the Sensory Profile and the School Companion findings on the same children, hypothesizing that they each provide contextually specific information about the sensory processing responses of children with autism at home (Sensory Profile) and at school (School Companion). If there is a relationship between context (home and school) and sensory processing patterns, then some aspects of sensory processing responses in

children with autism will be unique at school when compared to home. We hypothesized that 1.) There will be a low relationship between Seeking Quadrant Scores at home and school and 2.) There will be a high relationship between Avoiding Quadrant Scores at home and school. For this study, researchers focused only on the Seeking and Avoiding quadrants. We hypothesize that the Active quadrant behaviors from Dunn's Model of Sensory Processing (i.e., Avoiding and Seeking) would be more noticeable making it easier for the parents and the teacher to report and that these two quadrants would have the most difference in parent and teacher responses.

Method

Participants

Participants of this study were part of a larger study conducted from September 2005 to March 2006 to establish validity and reliability for the School Companion. The sample for this study included 56 students with autism (49 male and 7 female) and the public school teachers of the 56 students with autism from across the United States; these teachers completed the School Companion on students. The teachers reported the diagnoses based on school records: children with multiple diagnoses were excluded from the data set.

Due to missing data, 49 pairs of children with autism and their teachers were eligible for this study. The 49 students (43 male and 6 female) ranged in age from 3 years 3 months to 11 years 11 months (see Table 1). Five of the children received one service (i.e. Occupational Therapy, Physical Therapy, Speech-Language Therapy,

Special Education, and Counseling), ten children received two services, and 34 students received more than two services (see Table 2). Eighteen percent of the children were from various ethnic backgrounds (4 African-American, 2 Asian, 1 Hispanic, 2 Other/Multiracial) and 82% were White (*n* = 40).

The teachers had a range of teaching experience from 0 to 26+ years and education levels ranging from no degree to a Doctorate degree (no degree = 1, Bachelor's degree = 22, Master's degree = 23, Doctorate degree = 2, missing = 1) (see Table 3). Seven teachers had contact with the students two days a week, 17 teachers had contact with the student three to four days a week, and 25 of the teachers had contact with the student daily (see Table 4). Most of the teachers had only one year of contact with the student (*n* = 30), but some teachers had multiple years of contact (two years = 8, three years = 4, 4 years = 2, 5 or more years = 5).

In addition, the parents of the same children completed the Sensory Profile Caregiver Questionnaire. The education levels of the mothers and fathers (based on teacher report) ranged from 11 years of school or less (mother = 0, father = 2) to 16 years of school or more with the majority of the parents having 16 years of school or more (mother = 21, father = 21) (see Table 5). Other education levels included 12 years of school or a GED (mother = 12, father = 10), 13 to 15 years of school (mother = 16, father = 15), and one parent was unreported (mother = 0, father = 1).

Instruments

The Sensory Profile (Dunn, 1999) is a caregiver questionnaire that consists of 125 items which describe a child's response to sensory experiences. The items are

divided into three main sections: Sensory Processing, Modulation, Behavioral and Emotional Responses. The items of the questionnaire also form nine meaningful groups or factors that characterize children by their responsiveness to sensory input. The Supplement Summary Score Sheet to the Sensory Profile (Dunn, 2006b) provides four Quadrant Scores (Registration, Seeking, Sensitivity, and Avoiding) that correspond to the Dunn's Model of Sensory Processing (Dunn, 1997) (see Figure 1). According to the model, Registration is described as the degree to which a child misses sensory input and Seeking is the degree to which a child obtains sensory input. Sensitivity is the degree to which a child notices sensory input and Avoiding is the degree in which a child is bothered by sensory input. Parents respond to each statement reporting the frequency with which their child engages in a behavior using a 5-point Likert scale (i.e., 1 = always, 100% of the time; 2 = frequently, 75% of the time; 3 = occasionally, 50% of the time; 4 = seldom, 25% of the time; and 5 = never, 0% of the time). The Caregiver Questionnaire and the Summary Score Sheet take approximately 30 minutes to complete and the researchers calculated the Supplement Summary Score Sheet within SPSS using the raw scores.

The Sensory Profile School Companion (Dunn, 2006a) is a 62 item teacher questionnaire; the items describe a student's response to common sensory experiences in the school context. Because the School Companion is designed to be used in conjunction with the Sensory Profile, the School Companion uses the same 5-point Likert scale and scoring procedures as the Sensory Profile. The Teacher Questionnaire provides the same four Quadrant Scores (Registration, Seeking,

Sensitivity, and Avoiding) corresponding to Dunn's Model of Sensory Processing (Dunn 1997), four School Factor Scores (School Factors 1, 2, 3, and 4), and Section Scores for four sensory groups and one behavior group (Auditory, Visual, Movement, Touch, and Behavior). Teachers will need approximately fifteen minutes to complete the Teacher Questionnaire, and the researchers calculated the Scoring Summary using the raw scores within SPSS.

In addition, the teachers completed a demographic data sheet which included the teacher's education level/degree attained, frequency of teacher contact with students, years of teacher contact with students, and years of teaching experience. Teachers also reported the education level of the parents.

Procedures

To prevent a conflict of interest, an independent testing company sent packets to teachers and parents of children with autism. The packets included a cover letter with instructions, a demographic data sheet, a consent form, and the Sensory Profile and School Companion questionnaires to complete. Teachers completed the demographic data sheet, consent form, and the School Companion while the parents completed the Sensory Profile. The participants returned the material to the testing company within two months of when the participants received the packets. The testing company compiled the data into de-identified files and forwarded them to the researchers. The researchers calculated summary scores using the raw scores and conducted statistical analyses using SPSS.

Data Analysis

To determine the relationship between home and school reports of sensory processing patterns in children with autism, researchers conducted correlational analyses using the Avoiding and Seeking Quadrant Scores from the School Companion with the corresponding Avoiding and Seeking Quadrant Scores from the Sensory Profile. We hypothesized that the school's context may restrict Seeking patterns which are demonstrated at home, whereas behaviors associated with Avoiding patterns maybe more likely to occur in both the home or school context. Researchers conducted one-tailed Spearman rank correlations with a bivariate correlation design. Spearman rank was chosen because data from a Likert scale provides non-parametric data. The *p* value was set at the standard level of .05. Researchers used SPSS 16 to complete the correlational analyses and frequency distributions of the demographics.

Results

Table 6 summarizes the results of the correlations using the Avoiding and Seeking Quadrant Scores from the Sensory Profile (parent report) and School Companion (teacher report). The Avoiding Quadrants had a correlation of .59 (p = .01). The Seeking Quadrants correlation was also a positive correlation with a coefficient of .45 (p = .01).

Due to missing data, only 49 pairs of the 56 pairs of teachers and their students with autism were eligible for the study. In addition, researchers excluded cases pairwise in the correlations to minimize the effect of missing data. For this

reason, the number of participants reported in the correlation table is variable (see Table 6).

When the data was plotted, there was an outlier in both the Seeking and Avoiding results (see Figures 2 and 3). When the outliers were excluded, the strength of the correlations improved. However, the demographics proved there was no reason to exclude the outliers from the result. The reported results include data from the outliers.

Discussion

In this study, researchers examined the relationship between sensory processing patterns at home and school in children with autism. Specifically, researchers correlated the Seeking Quadrant Scores from the Sensory Profile (completed by the parents) and the School Companion (completed by the teacher). Researchers also correlated the Avoiding Quadrant Scores from each of the assessments. Data analysis revealed statistically significant correlations with both good and fair correlations suggesting sensory processing patterns have both universal qualities (i.e., the impact is the same everywhere) and context specific qualities (i.e., the impact is specific to a situation or activity) in children with autism.

The Avoiding Quadrant has a moderate to good correlation coefficient (.59) (Portney & Watkins, 2000) suggesting a child's reactions of being overwhelmed by sensory experiences might sometimes be similar at home and school. Perhaps children with autism are universally overwhelmed and avoid sensations across contexts. For example, both teachers and parents may report students with autism

hold their hands over their ears to protect their ears from sound, avoid eye contact, or withdraw from changes in the routine. The context has the potential to provide multiple sensory experiences; since it doesn't take much for a child with avoiding patterns to be overwhelmed, stimuli that trigger avoiding reactions can occur anywhere. On the other hand, since the correlation was not perfect, the data suggests that there are also unique circumstances at home and school. A family with one child may have a quieter context than at school, so the parents wouldn't see as many auditory reactions as the teacher does with a classroom full of students.

As practitioners, these findings are helpful for intervention planning. Both parents and teachers could implement strategies that will minimize the sensory experiences to reduce the child's need to use avoiding behaviors. There are situations in both contexts which may be especially overwhelming (i.e. school assemblies, fire drills, shopping at a department store with mom, or getting a haircut); therapists might want to ask additional questions about these high risk situations when children have avoiding patterns so they can create strategies to prevent challenging behaviors. Encouraging parents and teachers to discuss a student's sensory preferences across contexts can provide additional information that will assist in determining which situations are the most overwhelming for the student and help in planning more effective interventions.

The Seeking Quadrant correlation (.45) is in the fair range (Portney & Watkins, 2000). For seeking responses, expectations and limitations of a particular context may contribute to the fair correlation between home and school. For

example, a child may sing out loud at home and it might be considered delightful, but this behavior would be more disruptive in the classroom setting, resulting in a difference in reporting by the parents and teachers. Some parents may observe their children in multiple unstructured contexts where seeking behaviors are acceptable and encouraged. Other parents might provide a lot of structure which guides the child's responses. In contrast, teachers may notice seeking behaviors during structured times such as seatwork which is a time when the student is expected to be more controlled, or not take note of seeking behaviors during recess since everyone is more active. On the other hand, a child with seeking preferences may "hold it together" during the school day, but exhibit more seeking behaviors when arriving home. As a result, the seeking patterns at home and school may require special attention to understand the impact of seeking on the children's ability to participate in daily life. Discussion provides a more comprehensive understanding of the student's unique sensory processing needs related to seeking.

As illustrated in Table 6, the correlations using the corresponding Seeking and the corresponding Avoiding Quadrant Scores are significant. However, there are also significant correlations between the School Companion Avoiding Quadrant Score and the Sensory Profile Seeking Quadrant Score (.42) (p = .05) as well as, the School Companion Seeking Quadrant Score and the Sensory Profile Avoiding Quadrant Score (.46) (p = .01). Both of these correlations fall in the fair range. Perhaps significant correlations were found across these quadrants because according to Dunn's Model of Sensory Processing (Dunn, 1997) (see Figure 1), both Avoiding and

Seeking patterns are Active self-regulation patterns. Self-regulation is on a continuum and is defined as the strategy a person uses to manage his or her own needs and preferences (Dunn 2006a). Perhaps the children's needs to control their own sensory input, whether it be to get more (i.e., Seeking) or get less (i.e., Avoiding) is reflected in these fair correlations.

The literature on multiple informants indicates when parents and teachers are asked the same question, the answers are only slightly correlated suggesting each informant has a unique view (Achenbach, McConaughy, & Howell, 1987; De Los Reyes & Kazdin, 2005; de Nijs et al., 2004; Kumpulainen et al., 1999). This literature also reiterates the importance of receiving information from both the parents and the teacher during the assessment process and the necessity of using context specific assessments (Achenbach et al., 1987). Additionally, having both home and school information provides an opportunity to identify successful strategies from parents and teachers that may be useful in the other context. Furthermore, using context specific assessments (home and school versions) can provide a way to respectfully discuss what is happening at home and school without suggesting that either the parents or the teachers are providing the 'correct' perspective.

We know from the literature that children with autism have unique sensory processing patterns (Ermer & Dunn, 1998; Kientz & Dunn, 1997; Ornitz, 1974; Rapin, 1991; Tomchek & Dunn, 2007; Watling, Deitz, & White, 2001) when compared to typically developing peers. This study illustrates that for children with autism, behavioral responses to sensory experiences seem to be context related,

suggesting that simply knowing a child's sensory processing patterns without considering contextual factors would be insufficient information for comprehensive intervention planning.

Implications for Occupational Therapy Practice

The results of this study support the need to assess sensory processing patterns in children with autism across contexts. The School Companion may be a valuable addition to the Sensory Profile measure in accomplishing this goal. With both measures built on the same conceptual foundations, therapists can examine the impact of sensory processing overall in everyday life from the parents (using the Sensory Profile) and in the specific circumstance of school from the teacher (using the School Companion). Having more pieces of the puzzle of autism may also help provide more effective and individualized interventions.

Having data to support the concept that the context may be a factor in one's sensory processing provides a respectful way of discussing the similarities and differences between home and school as unique settings for the children to thrive.

Limitations

The small sample size limits generalizability. However, the sample included children with a distribution of age, race, involvement in special education (i.e. number of services, frequency of teacher contact), and parent education levels, increasing the confidence that the results are relevant for a larger population of children with autism. There are other relationships and comparisons that are likely to increase our understanding about context and sensory processing. Future studies need

to investigate all patterns of sensory processing, and to consider home and school relationships for children without disabilities as well.

Conclusion

Findings from this study provide initial evidence that there is a relationship between sensory processing and context for children with autism. Relationships between home and school sensory processing patterns in this study suggest that we must consider the context when interpreting findings with children who have autism. Comprehensive assessment may need to include information about reactions at home and school to make the best possible intervention plans.

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Figure Caption

Figure 1. Dunn's Model of Sensory Processing

	Behavioral Response/Self-Regulation Continuum	
Neurological Threshold	PASSIVE	ACTIVE
High Threshold (habituation)	**Registration**	**Seeking**
Low Threshold (sensitization)	**Sensitivity**	**Avoiding**

Reprinted with permission from Dunn, W., (1997). The impact of sensory processing abilities on the daily lives of young children and families: A conceptual model. *Infants and Young Children*, 9(4), 23-35.

Figure Caption

Figure 2. Scatterplot for Seeking Quadrant Score

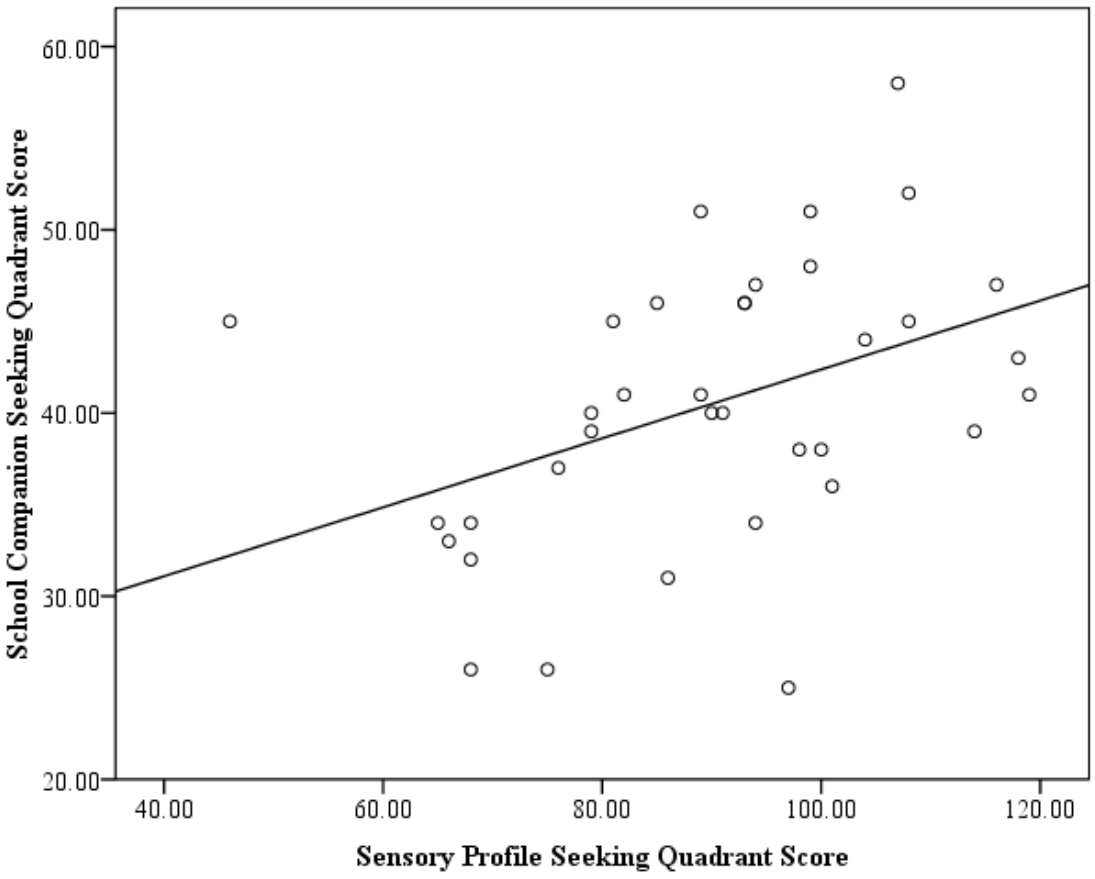
School Companion Seeking Quadrant Score
60.00
50.00
40.00
30.00
20.00
40.00
60.00
80.00
100.00
120.00
Sensory Profile Seeking Quadrant Score

Figure Caption

Figure 3. Scatterplot for Avoiding Quadrant Score

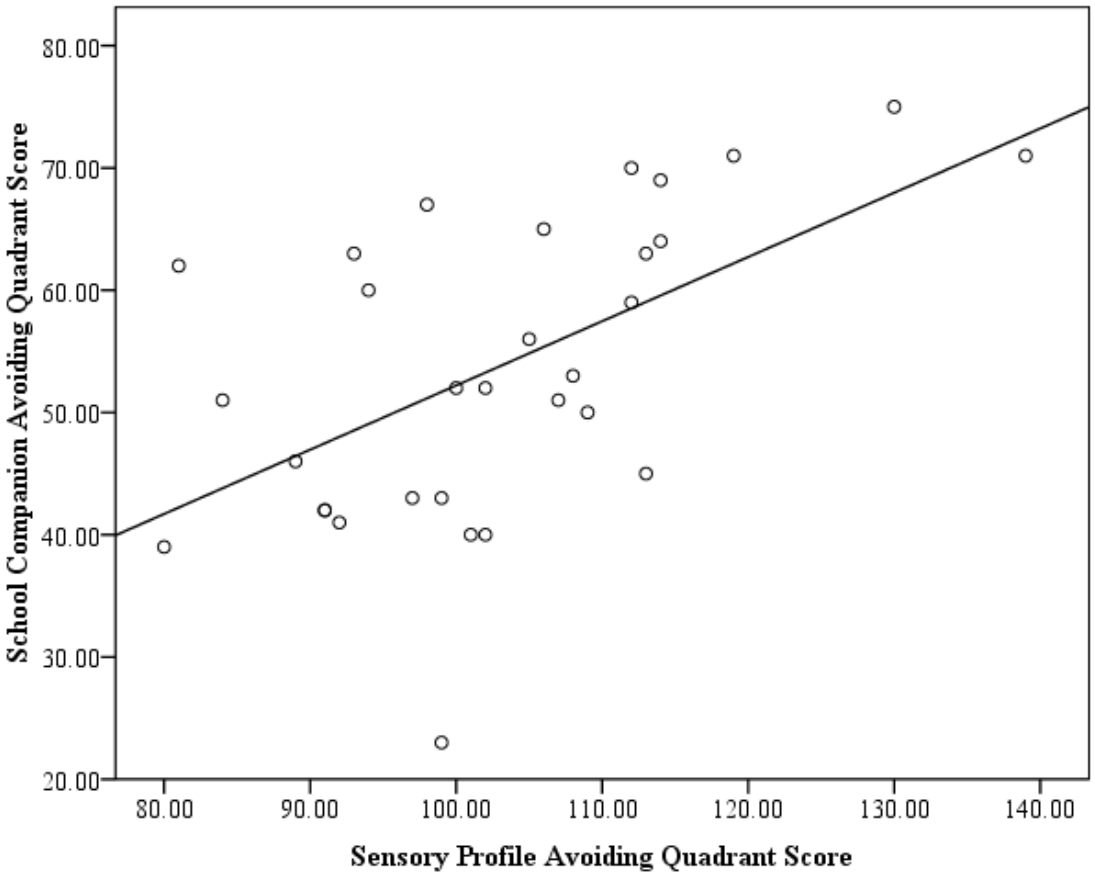
School Companion Avoiding Quadrant Score
80.00
70.00
60.00
50.00
40.00
30.00
20.00
80.00
90.00
100.00
110.00
120.00
130.00
140.00
Sensory Profile Avoiding Quadrant Score

Table 1

Distribution of Children with Autism by Age and Gender

	Children with Autism (*N* = 49)			
	Male (*n* = 43)		**Female (*n* = 6)**	
Age	*n*	% of sample	*n*	% of sample
3.0 – 5.11	20	40.82	2	4.08
6.0 – 8.11	12	24.49	1	2.04
9.0 – 11.11	11	22.45	3	6.12
Total	43	87.76	6	12.24

Table 2

Distribution of Children with Autism by Race/Ethnicity and Amount of Services Received

	Children with Autism (*N* = 49)	
Race/Ethnicity	*n*	% of Sample
African American	4	8.16
Asian	2	4.09
Hispanic	1	2.04
White	40	81.62
Other/Multiracial	2	4.09
Total	49	100.00
Services Received		
One	5	10.21
Two	10	20.40
More Than Two	34	69.39
Total	49	100.00

Table 3

Distribution of Teachers by Education Level/Degree Attainment and Years of Teaching Experience

	Teachers of Students with Autism (*N* = 49)	
Education Level/Degree	*n*	% of Sample
No Degree	1	2.04
Bachelor's Degree	22	44.89
Master's Degree	23	46.94
Doctorate Degree	2	4.09
Missing	1	2.04
Total	49	100.00
Years of Teaching		
0 - 10	18	36.73
11 - 20	18	36.73
More than 20	13	25.54
Total	49	100.00

Table 4

Distribution of Frequency by Teacher Contact with Students and Years of Teacher Contact with Students

	Teachers of Students With Autism (*N* = 49)	
Frequency of Contact	*n*	% of Sample
2 days/week	7	14.29
3-4 days/week	17	34.69
Daily	25	51.02
Total	49	100.00
Years of Contact		
1 year	30	61.22
More than 1 year	19	38.78
Total	49	100.00

Table 5

Distribution of Parents of Children with Autism by Education Levels

	Mother (*N* = 49)		**Father (*N* = 49)**	
Education Levels	*n*	% of Sample	*n*	% of Sample
11 years of school or less	0	0.00	2	4.09
12 years of school or GED	12	24.49	10	20.40
13 to 15 years of school	16	32.65	15	30.61
16 years of school or more	21	42.86	21	42.86
Not Reported	0	0.00	1	2.04
Total	49	100.00	49	100.00

Table 6

Correlations between the School Companion and Sensory Profile Avoiding and Seeking Quadrant Scores for Children with Autism

		Sensory Profile Quadrants	
School Companion Quadrants		Avoiding	Seeking
Avoiding	correlation coefficient	.59**	.42*
	N	31	30
Seeking	correlation coefficient	.46**	.45**
	N	37	36

**Correlation is significant at the .01 level (1-tailed)

*Correlation is significant at the .05 level (1-tailed)

Note. Variable *N* counts due to missing data.

Appendix A: Comprehensive Literature Review

Comprehensive Literature Review

Introduction

With a cause for autism not yet understood, much of the focus is on effective interventions for children with autism. Much of this responsibility is falling on the educational system due to federal laws and the fact children spend most of their day at school. The public schools must be ready to provide support so these children might be successful with their peers at school. One of the many difficulties children with autism face is an unusual way of responding to sensory experiences (Center for Disease Control and Prevention, 2007; Rapin, 1991; Strock, 2004). Researchers have shown sensory processing affects a child's ability to learn (Ayres, 1979; Dunn & Donaldson, 2001; Dunn, 2001). For these reasons, education teams need the appropriate tools to identify and design effective interventions specific to the education environment.

Occupational therapists offer a unique perspective in providing service for children by considering the role sensory processing has on behavior and learning. From the sensory integrative approach, many of the behaviors observed in children with autism originate from the desire to seek out, avoid, or modulate sensory stimulation. Determining a child's sensory preferences and thresholds for sensory stimuli, can not only help explain behaviors but also provide information to better support the child in his/her specific environment. A contextually relevant evaluation

of sensory processing for children with autism is essential for occupational therapy assessment.

Therefore, the purpose of this study is to determine the relationship between sensory processing and context. To address this purpose, we examined the Sensory Profile and Sensory Profile School Companion findings on the same children, hypothesizing that they each provide contextually specific information about the sensory processing responses of children with autism at home (Sensory Profile) and school (Sensory Profile School Companion). If there is a relationship between context and sensory processing patterns, then some aspects of sensory processing responses in children with autism will be unique at school when compared to home. We hypothesize that 1.) There will be a low relationship between Seeking Quadrant Scores at home and school and 2.) There will be a high relationship between Avoiding Quadrant Scores at home and school. For this study, researchers focused only on the Seeking and Avoiding quadrants. We hypothesize that the Active quadrant behaviors from Dunn's Model of Sensory Processing (i.e., Avoiding and Seeking) would be more noticeable making it easier for the parents and the teacher to report and that these two quadrants would have the most difference in parent and teacher responses.

The Challenge of Understanding and Serving Children with Autism

Autism is a neurodevelopmental disorder characterized by impairments in social skills, nonverbal and verbal communication as well as, demonstrating repetitive behaviors and unusual interests (American Psychiatric Association, 2000; Corsello,

2005; Rapin, 1991). In addition to these core characteristics, many children with autism have unusual ways of learning, attending, and responding to sensory experiences (Rapin, 1991; Strock, 2004). Children with autism may be sensitive and overreact to auditory stimulation and withdraw or may seek out proprioceptive and vestibular input in the way of self-stimulatory, repetitive behaviors such as; rocking, spinning, or flapping their hands (Case-Smith & Bryan, 1999). Each of these characteristics is on a spectrum and could range from mild to severe and often differ from one child to another (Mays & Gillon, 1993). Autism occurs in all racial, ethnic, and socioeconomic groups and is four times more likely to affect boys than girls ("Autism Society of America," 2007).

The prevalence of autism spectrum disorders (ASD) in the United States of America is on the rise affecting 1 in 150 births (Center for Disease Control and Prevention, 2007). The *Diagnostic and Statistical Manual of Mental Disorders* (American Psychiatric Association, 2000) includes autism as one of the five pervasive developmental disorders (PDD), which is more commonly referred to as ASD. Autism is the most common ASD of the five disorders ("Autism Society of America," 2007). In February 2007, a study was conducted by the Autism and Developmental Disabilities Monitoring (ADDM) Network, which is a group of programs funded by the Centers for Disease Control and Prevention. The findings estimated that 10 percent of U.S. eight-year-old children were identified as having ASD (Center for Disease Control and Prevention, 2007).

Some say we are in the midst of an autism epidemic, while others would argue the changes in the diagnostic criteria for autism, along with increased recognition of autism by professionals and the public may all be contributing factors (Strock, 2004). Nevertheless, it is clear that more children, families, and communities are dealing with the challenges of autism than in years past, and the increase in incidence creates pressure to characterize the children's behaviors properly so we can plan effective interventions to meet their needs.

One critical factor the education system faces in serving children with autism, involves conducting valid and reliable assessments to determine the children's learning strengths and needs. Many authors discuss sensory responses as characteristics that may interfere with both assessment and educational planning (Ayres, 1979; Case-Smith & Bryan, 1999; Case-Smith & Miller, 1999; Cook, 1991; Kientz & Dunn, 1997; Larson, 1982). If the nature of children's sensory processing patterns is better understood, then professionals will have important information to guide decisions.

Evaluation within the Educational System

Under the Individuals with Disabilities Education Improvement Act (IDEA) of 1990 (P.L. 105-117), children that are age 3 to 21 and qualify for special education and related services will receive services in the least restrictive environment, suggesting the child be included in a typical classroom as much of the school day as appropriate. The 2004 reauthorization of IDEA (P.L. 108-448) and the 2001 No Child Left Behind legislation (P.L. 107-110) state children should receive support and

special instruction to be successful in the general education curriculum and early identification is important to a child's success.

These laws have changed the classroom dynamics. One classroom now includes students of diverse learning styles, learning abilities, and behaviors. This can be difficult for general education teachers to manage and teach curriculum at different levels. In addition, it is known that children benefit from positive relationships with their teachers. A study conducted by Robertson, Chamberlain, and Kasari in 2003 examined the relationship between general education teachers and students with autism included in the regular classroom. The authors were interested in how the unusual behaviors and social difficulties of students with autism affected the relationships with their teachers. The teachers reported a higher rating of behavior problems lessened the quality of the teacher-student relationship. The authors also reported that the quality of the teacher-student relationship was associated with the students' relationships with classmates and the student's level of social inclusion in the classroom.

Children with autism have different learning styles than a typical child so they need special instruction to meet their learning needs (Case-Smith & Miller, 1999; Huebner, 1992; Mays & Gillon, 1993; Rapin, 1991; Simpson, de Boer-Ott, & Smith-Myles, 2003). Professionals in regular education may not be prepared to meet the special challenges of children who have autism without the support of special education and related service expertise (Simpson et al., 2003). To support children with autism in the classroom, school professionals often use assessments to determine

a child's strengths and areas of need. One of the areas that researchers have shown affects a child's ability to learn is sensory processing (Ayres, 1979; Dunn & Donaldson, 2001; Dunn, 2001). Specifically, children with autism sometimes fail to notice sensory input that is important, and other times are overly sensitive to sensory input and withdraw (Ermer & Dunn, 1998; Kientz & Dunn, 1997; Ornitz, 1974; Rapin, 1991; Tomchek & Dunn, 2007; Watling, Deitz, & White, 2001). This pattern of responding makes it difficult for the child to learn because the child misses important information needed to profit from instruction. Including assessment of sensory processing in the educational assessment plans with children who have autism may facilitate individualized intervention planning.

Methods for Assessing Sensory Processing

Many of the sensory processing assessments available measure a child's abilities through direct observation or requiring a child to perform a task. For example, the Sensory Integration and Praxis Tests (SIPT) are standardized subtests used to assess children aged 4 to 8.11 years old (Ayres, 1989; Bundy, Lane, & Murray, 2002; Dunn, 1994). However, the SIPT requires special training to administer and often takes several hours to complete the assessment. This is a considerable amount of time for a child to attend to a task and most children with autism would be unable to meet the standardized requirements of the SIPT (Kientz & Dunn, 1997). The SIPT assesses many areas of sensory processing, including vestibular, proprioceptive, kinesthetic, tactile, and visual systems (Ayres, 1989).

The DeGangi-Berk Test of Sensory Integration (TSI) is also a standardized sensory processing assessment and like other standardized tests, the SIPT and the TSI do not provide information on how a child performs in a natural environment (Dunn, 1994). This assessment focuses on younger children aged 3 to 5 years old (Berk & DeGangi, 1983; Kientz & Dunn, 1997). The test assesses bilateral motor integration, postural control, and reflex integration but is not sensitive to tactile processing abilities (Dunn, 1994; Kientz & Dunn, 1997).

As it is frequently difficult for children with autism to attend to the requirements of standardized tests, some therapists use nonstandardized measures, including interviews and checklists to assess sensory processing (Cook, 1991). The Touch Inventory for Preschoolers (TIP) (Royeen, 1987) and The Touch Inventory for Elementary School Aged Children (TIE) (Royeen & Fortune, 1990) are both interview assessment tools designed for either preschool-aged children or school-aged children up to age 12. The assessments are designed to evaluate a child's tactile processing abilities. While the assessment may provide information about the tactile system, professionals are often interested in assessing all the sensory systems (Dunn, 1994). The questions on the TIP are answered by the child's teacher and on the TIE the child themselves answers the questions.

Another type of sensory processing assessment is a sensory history questionnaire, which does identify sensory processing difficulties related to the context in which they occur (Kientz & Dunn, 1997). Behavior is influenced by the environment and therefore, it is important to take a person's environment or context

into consideration (Dunn, Brown, & McGuigan, 1994). Larson (1982) used a sensory history form to assess tactile defensiveness in developmentally delayed children and reported that a sensory history is an effective way to assess tactile defensiveness. Dunn (1999) developed a sensory history form called the Sensory Profile. In preliminary studies, the Sensory Profile was found to distinguish sensory patterns between children with and without autism (Ermer & Dunn, 1998; Kientz & Dunn, 1997). The Sensory Profile is also effective in identifying behaviors children with autism often demonstrate to help professionals identify sensory-related behaviors. However, behaviors assessed by the Sensory Profile are not specific to behaviors that would occur in the classroom setting, where a school-aged child spends most of his/her day.

Home and school contexts are unique and, therefore, contextually relevant assessments are essential. At this time, there are only two published assessments specifically for use in the schools. The Sensory Processing Measure - School (SPM - School) provides standard scores for children five to twelve years old in the areas of praxis and social participation, as well as, visual, auditory, tactile, proprioceptive and vestibular sensory systems (Miller-Kuhaneck, Henry, Glennon, & Mu, 2007). The forms can be completed in 15-20 minutes by the primary classroom teacher (Main Classroom Form) and other school personnel (School Environments Form) using a 4-point Likert scale. The authors of the SPM - School suggest one Main Classroom Form and multiple School Environments Forms be completed on each child to access up to seven school environments including; classroom, cafeteria, school bus, recess,

and music, art, and physical education classes (Miller-Kuhaneck et al., 2007). It is recommended that all the forms be completed to compare a child's sensory performance across school environments. As a result, there could be as many as seven forms filled out on one child.

The second available school-based sensory processing assessment is the Sensory Profile School Companion (hereafter referred to as the School Companion) (Dunn, 2006). The School Companion is the only assessment that offers information on a child's sensory patterns, and therefore, provides more understanding into the child's overall sensory difficulties. These patterns are based on Dunn's Model of Sensory Processing, which is a tested conceptual model (i.e., sensory processing patterns: Seeking, Avoiding, Sensitivity and Registration) (Dunn, 1997). The School Companion is built on this conceptual model, making comparisons more aligned with constructs from prior studies and the literature as well as, providing more understanding into the child's overall sensory difficulties. The School Companion also offers sensory system scores (i.e., visual, auditory, touch, movement) and a behavior score. Because teachers are completing this form, there are also four School Factor Scores, reflecting the teacher and classroom perspectives (Dunn, 2006). Each School Factor Score combines two sensory processing patterns based on Dunn's Model of Sensory Processing. The ways in which the student learns best in a classroom environment are reflected when the two sensory patterns are compared. The School Factors assess the student's need for external supports, the student's awareness and attention within the classroom, the student's range for tolerance for

sensory input, and the student's availability for learning. The School Companion is designed for children aged three to eleven years old. The age range coincides with the research stating the average age for a diagnosis of autism is 3.1 years old and supports research suggesting children with autism benefit the most from early identification and intervention (Corsello, 2005; Mandell, Novak, & Zubritsky, 2005). The child's teacher uses a 5-point Likert scale to complete the 62 item questionnaire regarding the child's responses to daily sensory experiences in the classroom. Only one form is needed since the classroom teacher knows the student the best and is more likely to understand the skilled observations necessary to make hypotheses. The School Companion is designed to be used in conjunction with the Sensory Profile (Dunn, 1999) which solicits the caregivers' input, providing a more comprehensive view of the child's sensory processing abilities.

With both the SPM-School and School Companion being new assessments there is limited published literature available. However, the authors of both assessments provide literature on the reliability and validity of the assessments. To investigate the reliability of the SPM-School, the authors examined the internal consistency of the assessment items using the Cronbach's alpha coefficient (Miller-Kuhaneck et al., 2007). Cronbach's alpha ranges from 0 to 1 with a .80 correlation or greater interpreted as an adequate reliability (DePoy & Gitlin, 1994). The SPM-School's authors reported .70 to .99 correlation ranges. Dunn (2006a) also used the Cronbach's alpha coefficient to report reliability with correlations ranging from .83 to .95. There is some controversy over whether the Cronbach's alpha is the most

effective analysis for reliability since the statistic only tells us whether the items in an instrument measures the same construct or if the items are redundant (DePoy & Gitlin, 1994; Portney & Watkins, 2000). Dunn also reports test-retest reliability coefficients ranging from .80 to .95 reflecting good to excellent stability of scores from the first rating the teacher reported on a child to the second rating the teacher reported on the same child (Dunn, 2006). Miller-Kuhaneck, et al (2007) used discriminat analysis to report the SPM-School has face validity or the assessment appears to test what it is intended to test, which is the least rigorous measurement for validity (Portney & Watkins, 2000). The SPM-School could correctly classify children typically developing 92.3% of the time and children with sensory difficulties only 72% of the time. The scores from the teacher responses on the School Companion were correlated with scores from the parent responses on the Sensory Profile and indicated contrasting high and low correlations, providing evidence of convergent and discriminant validity (Dunn, 2006). Convergent and discriminant validity are types of construct validity, which is the ability of an instrument to measure an abstract concept or construct (Portney & Watkins, 2000).

Identifying the Best Source for Evaluation Information

Research shows when teachers and parents are asked the same questions about a child, the responses are only slightly correlated suggesting that each informant has a unique view and one could not be substituted for the other (Achenbach, McConaughy, & Howell, 1987; De Los Reyes & Kazdin, 2005; de Nijs et al., 2004; Kumpulainen et al., 1999). In a benchmark study by Achenbach, McConaughy, and

Howell (1987), the authors did a meta-analysis of 119 studies and found there is a discrepancy in parent, teacher, child, mental health worker, observer, and peer responses to ratings of a child's social, emotional, or behavioral problems. In studies examining the agreement between parents and teachers concerning a child's behavior (attention-deficit disorder/hyperactivity disorder symptomatology or behavioral/emotional symptoms) the investigators agreed that it was important to obtain information from the teacher regarding the child's behavior in the classroom and from the parent regarding the child's behavior at home (de Nijs et al., 2004; Kumpulainen et al., 1999). Every person has their own point of view and experience. The low correlations between teacher and parent responses using the same questionnaire also suggest the variables differ from home and school and indicate the need for contextually designed assessments, as well as, different interventions and goals (Achenbach et al., 1987).

Undoubtedly, school and home versions of a measure have the potential to provide a wider range of data. Additionally, using two versions affords better communication between caregivers and school personnel making interventions more effective and customized for each child. Research shows that collaboration between teachers and therapists help students reach IEP goals and demonstrate success in performance areas (Dunn, 1990; Kemmis & Dunn, 1996). In a study conducted by Case-Smith (1995), collaboration among parents, teachers, and therapists was effective in assisting the student with generalizing skills in least restrictive environments.

There is a question about how home and school versions of sensory processing assessments correlate and differ from each other. If assessment of sensory processing is only about the children's reactions, then home and school assessment will be highly correlated. If however, the contexts of the children's reactions are an important factor, then there will be both similarities and differences that perhaps indicate the contribution of environment to behavior.

In sum, the prevalence of autism is on the rise and there is a strong need for effective intervention. The school system is expected to provide specialized instruction to meet the unique learning needs of all children, including children with autism. The research has shown that children with autism have unique sensory processing patterns affecting the way in which they respond in their everyday lives. Being able to determine the specific sensory processing patterns and how they might relate to participation at home and school will help professionals support participation by adjusting the environment to better fit children's learning needs.

Therefore, the purpose of this study is to determine whether the Sensory Profile and the School Companion provide contextually specific information about the sensory processing responses of children with autism at home and at school (respectively). If there is a relationship between environment and sensory processing patterns, then some aspects of sensory processing responses in children with autism will be unique at school when compared to home. Interventions will also need to be context specific when supporting children at home and school.

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Appendix B: Registration and Sensitivity Quadrant Score Correlation Table

Correlations between the School Companion and Sensory Profile Registration and Sensitivity Quadrant Scores for Children with Autism

		Sensory Profile Quadrants	
School Companion Quadrants		Registration	Sensitivity
Registration	correlation coefficient	.37*	.28
	N	24	21
Sensitivity	correlation coefficient	-.06	-.07
	N	30	26

*Correlation is significant at the .05 level (1-tailed)

Note. Variable *N* counts due to missing data.

Appendix C: Distribution by Grade Level

Distribution of Children with Autism by Grade Level

	Children with Autism (*N* = 49)	
Grade	*n*	% of Sample
Preschool	16	32.66
Kindergarten	11	22.24
First Grade	4	8.16
Second Grade	4	8.16
Third Grade	4	8.16
Fourth Grade	6	12.25
Fifth Grade	3	6.12
Sixth Grade	1	2.04
Total	49	100.00

Appendix D: Distribution by Language Spoken

Distribution of Language Spoken by Parents of Children with Autism

	Parents (*N* = 49)	
Language	***n***	**% of Sample**
English	48	98.00
Spanish	1	2.00
Total	49	100.00

Appendix E: Human Subjects Completion Certificate

Certificate of Completion

The University of Kansas Medical Center certifies that

Natalie Brown

has completed the

KUMC Tutorial on Human Subjects Protection and Research Requirements of the HIPAA Privacy Rule

Date: 9/5/2007

DISCLAIMER:

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Appendix F: Sensory Profile and Sensory Profile School Companion

The Sensory Profile Caregiver Questionnaire (1999) and Sensory Profile Summary Score Sheet (1999) created by Winnie Dunn, Ph.D., OTR, FAOTA are available through The Psychological Corporation, A Harcourt Assessment Company. See link for more information.

http://harcourtassessment.com/HAIWEB/Cultures/en-us/Productdetail.htm?Pid=076-1638-008&Mode=detail&Leaf=accessory&dsrc=076-1638-024#ISBN2

The Sensory Profile Supplement Summary Score Sheet (2006) is also created by Winnie Dunn, Ph.D., OTR, FAOTA and is available at the following link.

http://harcourtassessment.com/HAIWEB/Cultures/en-us/Productdetail.htm?Pid=015-8338-60X&Mode=detail&Leaf=accessory

The Sensory Profile School Companion Teacher Questionnaire (2006) and The Sensory Profile School Companion Scoring Summary (2006) are also created by Winnie Dunn, Ph.D., OTR, FAOTA and are available at the following link.

http://harcourtassessment.com/HAIWEB/Cultures/en-us/Productdetail.htm?Pid=076-1638-008&Mode=detail&Leaf=accessory&dsrc=076-1600-205#ISBN2